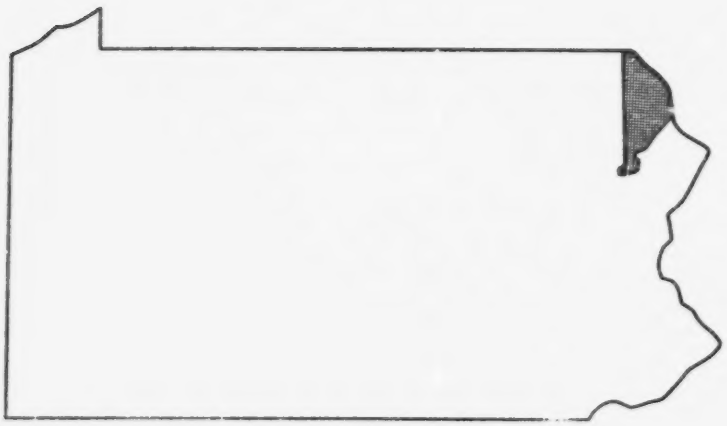
FEB 2 6 1988

FLOOD INSURANCE STUDY

TOWNSHIP OF LEHIGH, PENNSYLVANIA
WAYNE COUNTY



MARCH 4, 1988

Federal Emergency Management Agency

COMMUNITY NUMBER · 422167

NOTICE TO
FLOOD INSURANCE STUDY USERS

Communities participating in the National Flood Insurance Program (NFIP) have established repositories of flood hazard data for floodplain management and flood insurance study purposes. This Flood Insurance Study (FIS) may not contain all data available within the repository. It is advisable to contact the community repository for any additional data.

TABLE OF CONTENTS

		Page
1.0	INTRODUCTION	1
	1.1 Purpose of Study	1
	1.2 Authority and Acknowledgments	1
	1.3 Coordination	1
2.0	AREA STUDIED	2
	2.1 Scope of Study	2
	2.2 Community Description	2
	2.3 Principal Flood Problems	4
	2.4 Flood Protection Measures	4
3.0	ENGINEERING METHODS	4
	3.1 Hydrologic Analyses	4
	3.2 Hydraulic Analyses	5
4.0	FLOODPLAIN MANAGEMENT APPLICATIONS	6
	4.1 Floodplain Boundaries	6
	4.2 Floodways	9
5.0	INSURANCE APPLICATION	9
6.0	FLOOD INSURANCE RATE MAP	11
7.0	OTHER STUDIES	12

TABLE OF CONTENTS - continued

		Page
8.0	LOCATION OF DATA	12
9.0	BIBLIOGRAPHY AND REFERENCES	12

FIGURES

Figure 1 - Vicinity Map	3
Figure 2 - Floodway Schematic	10

TABLES

Table 1 - Summary of Discharges	5
Table 2 - Regulatory Data Table	7 - 8

EXHIBITS

Exhibit 1 - Flood Profiles	
Gouldsboro Lake Tributary	Panels 01P-02P
Lehigh River	Panels 03P-04P
Exhibit 2 - Flood Insurance Rate Map and Street Index	
Exhibit 3 - Elevation Reference Marks	

1.0 INTRODUCTION

1.1 Purpose of Study

This Flood Insurance Study investigates the existence and severity of flood hazards in the Township of Lehigh, Wayne County, Pennsylvania, and aids in the administration of the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973. This study has developed flood risk data for various areas of the community that will be used to establish actuarial flood insurance rates and assist the community in its efforts to promote sound floodplain management. Minimum floodplain management requirements for participation in the National Flood Insurance Program (NFIP) are set forth in the Code of Federal Regulations at 44 CFR, 60.3.

In some states or communities, floodplain management criteria or regulations may exist that are more restrictive or comprehensive than the minimum Federal requirements. In such cases, the more restrictive criteria take precedence and the state (or other jurisdictional agency) will be able to explain them.

1.2 Authority and Acknowledgments

The sources of authority for this Flood Insurance Study are the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973.

The hydrologic and hydraulic analyses for this study were prepared by the Philadelphia District of the U. S. Army Corps of Engineers (COE), for the Federal Emergency Management Agency (FEMA), under Inter-Agency Agreement No. EMW-85-E-1822, Project Order No. 1, Amendment No. 16. This work was completed in November 1986.

1.3 Coordination

In December 1984, an initial Consultation and Coordination Officer's (CCO) meeting was held with representatives from FEMA and the township to determine the streams to be studied by detailed methods. A search for basic data was made at all levels of government. Community officials supplied the COE (the study contractor) with a general highway map, and the U. S. Geological Survey (USGS) supplied topographic maps that were used in the preparation of this study.

On March 31, 1987, a final CCO meeting was held with representatives from FEMA, the township, and the study contractor to review the results of the study.

2.0 AREA STUDIED

2.1 Scope of Study

This Flood Insurance Study covers the [illegible] Township of Lehigh, Wayne County, Pennsylvania. [illegible] is shown on the Vicinity Map (Figure 1).

The following streams were studied by detailed methods. [illegible] Lake Tributary, from its confluence with the Lehigh River to the CONRAIL bridge; and the Lehigh River from Township Road T-[illegible] to the confluence of Gouldsboro Lake Tributary. The areas studied by detailed methods were selected with priority given to all known flood hazard areas and areas of projected development and proposed construction through November 1991.

The following streams were studied by approximate methods: the remaining portions of the Lehigh River, an unnamed tributary to the Lehigh River, an unnamed tributary to Lower Klondike Pond, Lehigh River, and [illegible]. Approximate analyses were used to study areas having a low development potential or minimal flood hazards. The scope and methods of study were proposed to and agreed upon by FEMA and the Township of Lehigh.

2.2 Community Description

The Township of Lehigh is located in southern Wayne County in northeastern Pennsylvania. It is bordered by the Townships of Clifton and Sterling to the north, the Township of Dreher to the east, the Township of Coolbaugh to the south, and the Township of Clifton to the west. The township covers an area of approximately 6,360 acres and had a 1980 population of 884. The projected population for the year 2000 is 945.

The township was established from the Township of Dreher in December 1883. The only village of significant size within the township is Gouldsboro; however, the township also has the county's second largest amount of acreage set aside for seasonal residences. In contrast to most of the county, Lehigh is characterized by numerous swampy areas and gently rolling hills with the terrain becoming steeper only in the southwestern section of the township. A 1986 land use summary indicates that the zoning for the township is predominantly residential.

Gouldsboro Lake Tributary flows in a northern direction through swampy areas to its confluence with the Lehigh River just north of Snag Pond. The majority of the residential portion of the township is drained by the Lehigh River and its tributaries. The headwaters of the Lehigh River are located in the northern section of the township. The Lehigh River flows in a generally southwestern direction through the swampy areas, several ponds, and forms the southwestern corporate limits where the terrain is steeper.

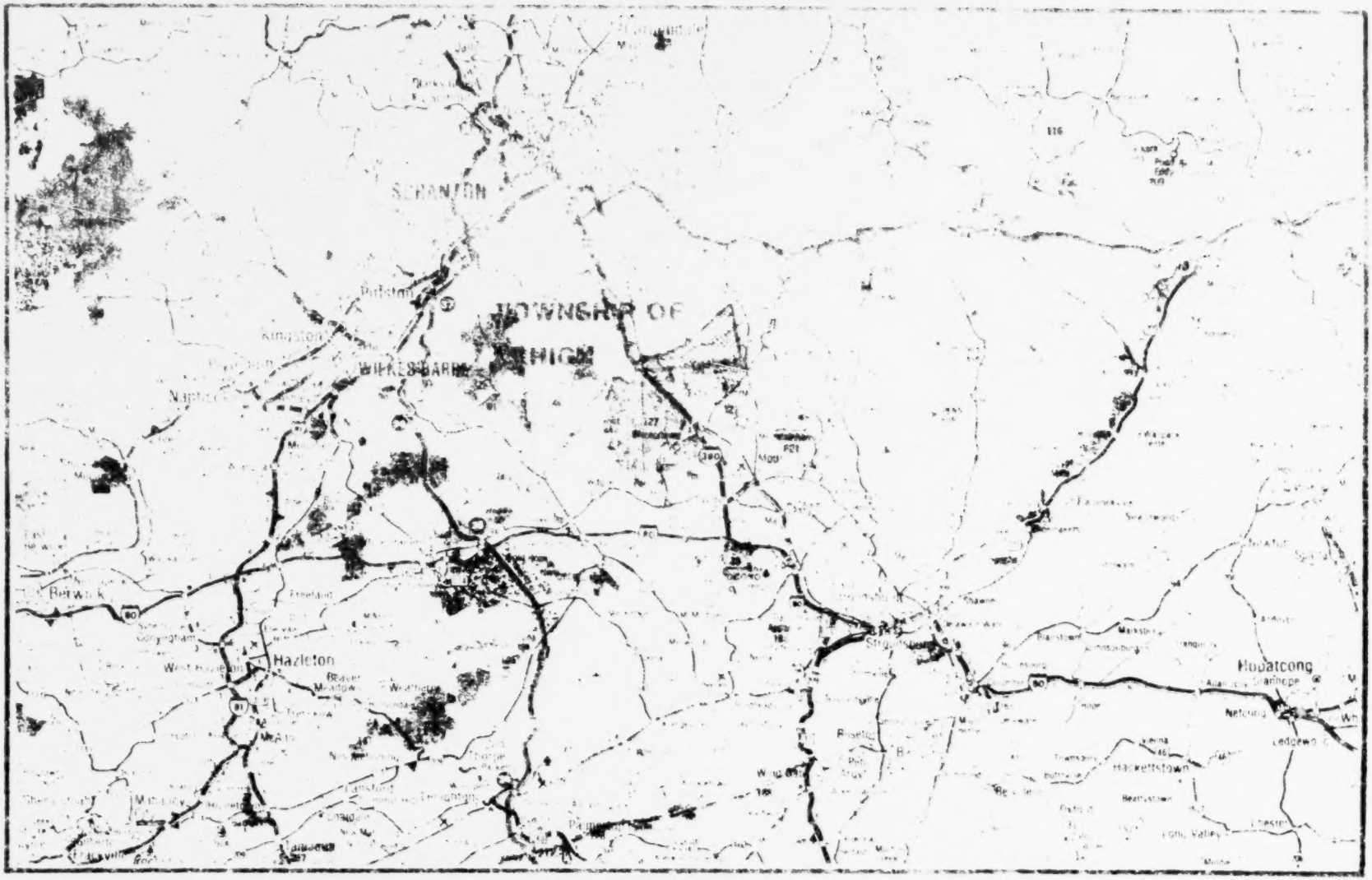


FIGURE 1

FEDERAL EMERGENCY MANAGEMENT AGENCY

TOWNSHIP OF LEHIGH, PA

(WAYNE CO.)

APPROXIMATE SCALE IN MILES 10 5 0 10 20 30

VICINITY MAP

The climate in this geographic area is characterized by temperatures ranging from an average high of 88 degrees Fahrenheit (31°C) in summer and 30°F in winter. The average annual rainfall for the region is 44 inches.

2.3 Principal Flood Problems

The principal flood problems in the township are associated with the Gouldsboro Lake Tributary and the Lehigh River near Gouldsboro. As recently as September 1985, flooding due to hurricane Gloria threatened the residents of Gouldsboro.

2.4 Flood Protection Measures

There are no local flood protection measures in the township. Residents of Lehigh depend on the usual warnings issued through radio, television, and local newspapers for information concerning possible flood conditions. Flood warnings and predicted flood peaks are issued by the National Oceanic and Atmospheric Administration (NOAA) Flood Forecasting Centers located at Harrisburg, Pennsylvania, and Trenton, New Jersey.

3.0 ENGINEERING METHODS

For the flooding sources studied in detail in the community, standard hydrologic and hydraulic study methods were used to determine the flood hazard data required for this study. A flood event of a magnitude which is expected to be equaled or exceeded once on the average during any 100-year period (recurrence interval) has been selected as having special significance for floodplain management and for flood insurance rates. This event, commonly termed the 100-year flood, has a 1 percent chance of being equaled or exceeded during any year. Although the recurrence interval represents the long term average period between floods of a specific magnitude, rare floods could occur at short intervals or even within the same year. The risk of experiencing a rare flood increases when periods greater than 1 year are considered. For example, the risk of having a flood which equals or exceeds the 100-year flood (1 percent chance of annual exceedence) in any 50-year period is approximately 40 percent (4 in 10), and, for any 90-year period, the risk increases to approximately 60 percent (6 in 10). The analyses reported herein reflect flooding potentials based on conditions existing in the community at the time of completion of this study. Maps and flood elevations will be amended periodically to reflect future changes.

3.1 Hydrologic Analyses

Hydrologic analyses were carried out to establish the peak discharge-frequency relationships for each flooding source studied in detail affecting the community.

All USGS stream gages with a reasonable number of years of record in Monroe, Wayne, Pike, and nearby counties were analyzed. A flood frequency analysis was performed on the streams studied by detailed methods to determine the 100-year flood. This produced records of drainage areas and 100-year flood events that were plotted to generate a regional curve.

A summary of the drainage area-peak discharge relationships for the streams studied by detailed methods is shown in Table 1, "Summary of Discharges."

TABLE 1 - SUMMARY OF DISCHARGES

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (sq. miles)	PEAK DISCHARGE (cfs) 100-YEAR
GOULDSBORO LAKE TRIBUTARY		
At its confluence with Lehigh River	7.3	1,055
Downstream of CONRAIL railroad	4.2	610
LEHIGH RIVER		
At Phillips Road	17.4	2,460

3.2 Hydraulic Analyses

Analyses of the hydraulic characteristics of flooding from the sources studied were carried out to provide estimates of the elevations of floods of the selected recurrence intervals.

Cross sections for the backwater analysis of the streams studied by detailed methods were determined using aerial photogrammetry and field surveys and were located at close intervals above and below bridges and culverts in order to compute the significant backwater effects of these structures (Reference 1). The ground control for the photogrammetry was acquired using aerial surveying techniques (Reference 2).

Locations of selected cross sections used in the hydraulic analyses are shown on the Flood Profiles (Exhibit 1) and the Flood Insurance Rate Map (Exhibit 2) where applicable.

Water-surface elevations of floods of the selected recurrence intervals were computed using the COE HEC-2 step-backwater computer program (Reference 3). Flood profiles were drawn showing computed water-surface elevations for floods of the selected recurrence intervals. Starting water-surface elevations for the streams studied by detailed methods were obtained from backwater computations of their respective main stems or from normal depth

computations, as appropriate. The results of the water surface elevation computations are tabulated for selected cross sections (Table 2).

Channel and overbank roughness factors (Manning's "n") used in the hydraulic computations were chosen using Chow's Open-Channel Hydraulics, and by engineering judgment based on field observations of the stream and floodplain areas (Reference 4). The channel "n" value for Gouldsboro Lake Tributary was 0.061, and the overbank "n" value was 0.090. The channel "n" value for the Lehigh River was 0.045, and the overbank "n" value was 0.090.

The hydraulic analyses for this study were based on unobstructed flow. The flood elevations shown on the profiles are thus considered valid only if hydraulic structures remain unobstructed, operate properly, and do not fail.

All elevations are referenced to the National Geodetic Vertical Datum of 1929 (NGVD). Elevation reference marks used in this study are shown on the maps; the descriptions of the marks are presented in Elevation Reference Marks (Exhibit 3).

4.0 FLOODPLAIN MANAGEMENT APPLICATIONS

The NFIP encourages State and local governments to adopt sound floodplain management programs. Therefore, each Flood Insurance Study provides 100-year flood elevations and delineations of the 100-year floodplain boundaries to assist communities in developing floodplain management measures.

4.1 Floodplain Boundaries

To provide a national standard without regional discrimination, the 1 percent annual chance (100-year) flood has been adopted by FEMA as the base flood for floodplain management purposes. For the streams studied in detail, the 100-year floodplain boundaries have been delineated using the flood elevations determined at each cross section. Between cross sections, the boundaries were interpolated using topographic maps at a scale of 1:24,000 with a contour interval of 20 feet (Reference 5).

For the streams studied by approximate methods, the 100-year flood boundaries were delineated using the Flood Hazard Boundary Map for the Township of Lehigh (Reference 6).

The 100-year floodplain boundaries are shown on the Flood Insurance Rate Map (Exhibit 2). On this map, the 100-year floodplain boundary corresponds to the boundary of the areas of special flood hazards (Zones A and AE). Small areas within the floodplain boundaries may lie above the flood elevations but cannot be shown due to limitations of the map scale and/or lack of detailed topographic data.

FLOODING SOURCE		STREAM CHANNEL			LEFT OVERBANK			RIGHT OVERBANK			100 YEAR FLOOD WATER SURFACE ELEVATION
CROSS SECTION	DISTANCE (FT)	WIDTH (FT)	DISCHARGE (CFS)	MEAN VELOCITY (FT/SEC)	WIDTH (FT)	DISCHARGE (CFS)	MEAN VELOCITY (FT/SEC)	WIDTH (FT)	DISCHARGE (CFS)	MEAN VELOCITY (FT/SEC)	
A	1250	10	150	1.7	145	400	0.6	295	500	0.5	1884.6
B	3150	220	690	0.4	360	250	0.1	430	120	0.1	1884.7
C	4000	35	260	1.4	260	530	0.6	95	260	0.6	1885.1
D	4975	35	390	[illegible]	20	30	0.7	305	630	0.8	1885.4
E	6400	15	170	[illegible]	65	110	0.7	375	770	0.7	1890.4
F	7750	25	140	0.8	380	480	0.3	325	430	0.3	1891.5

TABLE 2

FEDERAL EMERGENCY MANAGEMENT AGENCY

Township of Lehigh
Wayne County
Pennsylvania

REGULATORY DATA

Gouldsboro Lake Tributary

FLOODING SOURCE		STREAM CHANNEL			LEFT OVERBANK			RIGHT OVERBANK			100 YEAR FLOOD WATER SURFACE ELEVATION
CROSS SECTION	DISTANCE (FT)	WIDTH (FT)	DISCHARGE (CFS)	MEAN VELOCITY (FT/SEC)	WIDTH (FT)	DISCHARGE (CFS)	MEAN VELOCITY (FT/SEC)	WIDTH (FT)	DISCHARGE (CFS)	MEAN VELOCITY (FT/SEC)	
A	1000	5	180	3.9	720	1970	1.2	95	310	1.2	1816.2
B	1975	30	1740	10.6	80	10	0.9	130	700	2.7	1828.6
C	3225	5	810	14.7	5	40	2.7	150	1600	3.9	1840.1
D	4725	35	1730	11.4	10	60	3.2	85	670	3.7	1854.2
E	5900	30	1800	8.2	195	340	1.4	50	320	2.3	1863.9
F	7400	35	1610	8.9	120	680	2.8	25	170	2.8	1870.5
G	7800	75	1880	8.2	90	210	2.2	170	370	2.1	1875.6
H	10475	220	2000	1.1	60	130	0.4	395	330	0.3	1880.3
I	11500	65	1900	9.4	20	10	1.6	395	550	3.0	1881.2

TABLE 2

FEDERAL EMERGENCY MANAGEMENT AGENCY

Township of Lehigh
Wayne County
Pennsylvania

REGULATORY DATA

Lehigh River

4.2 Floodways

Encroachment on floodplains, such as structures and fill, reduces flood-carrying capacity, increases flood heights and velocities, and increases flood hazards in areas beyond the encroachment itself. One aspect of floodplain management involves balancing the economic gain from floodplain development against the resulting increase in flood hazard. For purposes of the National Flood Insurance Program, a floodway is used as a tool to assist local communities in this aspect of floodplain management. Under this concept, the area of the 100-year floodplain is divided into a floodway and a floodway fringe. The floodway is the channel of a stream, plus any adjacent floodplain areas, that must be kept free of encroachment so that the 100-year flood can be carried without substantial increases in flood heights. Minimum federal standards limit such increases to 1.0 foot, provided that hazardous velocities are not produced.

The area between the floodway and 100-year floodplain boundaries is termed the floodway fringe. The floodway fringe encompasses the portion of the floodplain that could be completely obstructed without increasing the water-surface elevation of the 100-year flood by more than 1.0 foot at any point. Typical relationships between the floodway and the floodway fringe and their significance to floodplain development are shown in Figure 2.

No floodways were calculated as part of this study.

5.0 INSURANCE APPLICATION

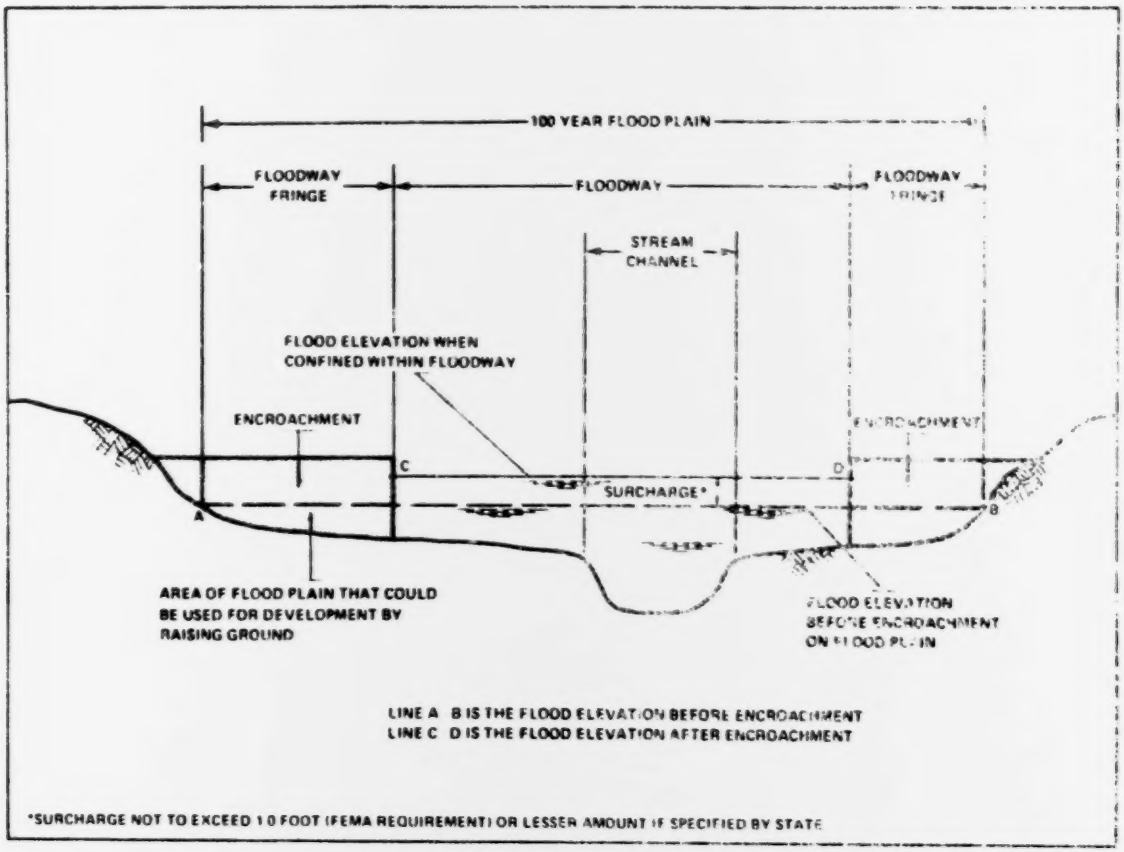
For flood insurance rating purposes, flood insurance zone designations are assigned to a community based on the results of the engineering analyses. These zones are as follows:

Zone A

Zone A is the flood insurance rate zone that corresponds to the 100-year floodplains that are determined in the Flood Insurance Study by approximate methods. Because detailed hydraulic analyses are not performed for such areas, no base flood elevations or depths are shown within this zone.

Zone AE

Zone AE is the flood insurance rate zone that corresponds to the 100-year floodplains that are determined in the Flood Insurance Study by detailed methods. In most instances, whole-foot base flood elevations derived from the detailed hydraulic analyses are shown at selected intervals within this zone.


100 YEAR FLOOD PLAIN
FLOODWAY FRINGE
FLOODWAY
FLOODWAY FRINGE
STREAM CHANNEL
FLOOD ELEVATION WHEN CONFINED WITHIN FLOODWAY
ENCROACHMENT
ENCROACHMENT
C
D
SURCHARGE*
A
B
AREA OF FLOOD PLAIN THAT COULD BE USED FOR DEVELOPMENT BY RAISING GROUND
FLOOD ELEVATION BEFORE ENCROACHMENT ON FLOOD PLAIN
LINE A B IS THE FLOOD ELEVATION BEFORE ENCROACHMENT
LINE C D IS THE FLOOD ELEVATION AFTER ENCROACHMENT
*SURCHARGE NOT TO EXCEED 1.0 FOOT (FEMA REQUIREMENT) OR LESSER AMOUNT IF SPECIFIED BY STATE

FLOODWAY SCHEMATIC Figure 2

Zone AH

Zone AH is the flood insurance rate zone that corresponds to the areas of 100-year shallow flooding (usually areas of ponding) where average depths are between 1 and 3 feet. Whole-foot base flood elevations derived from the detailed hydraulic analyses are shown at selected intervals within this zone.

Zone AO

Zone AO is the flood insurance rate zone that corresponds to the areas of 100-year shallow flooding (usually sheet flow on sloping terrain) where average depths are between 1 and 3 feet. Average whole-foot depths derived from the detailed hydraulic analyses are shown within this zone.

Zone A99

Zone A99 is the flood insurance rate zone that corresponds to areas of the 100-year floodplain that will be protected by a Federal flood protection system where construction has reached specified statutory milestones. No base flood elevations or depths are shown within this zone.

Zone V

Zone V is the flood insurance rate zone that corresponds to the 100-year coastal floodplains that have additional hazards associated with storm waves. Because approximate hydraulic analyses are performed for such areas, no base flood elevations are shown within this zone.

Zone VE

Zone VE is the flood insurance rate zone that corresponds to the 100-year coastal floodplains that have additional hazards associated with storm waves. Whole-foot base flood elevations derived from the detailed hydraulic analyses are shown at selected intervals within this zone.

Zone X

Zone X is the flood insurance rate zone that corresponds to areas outside the 500-year floodplain, areas within the 500-year floodplain, and to areas of 100-year flooding where average depths are less than 1 foot, areas of 100-year flooding where the contributing drainage area is less than 1 square mile, and areas protected from the 100-year flood by levees. No base flood elevations or depths are shown within this zone.

Zone D

Zone D is the flood insurance rate zone that corresponds to unstudied areas where flood hazards are undetermined, but possible.

6.0 FLOOD INSURANCE RATE MAP

The Flood Insurance Rate Map is designed for flood insurance and floodplain management applications.

For flood insurance applications, the map designates flood insurance rate zones as described in Section 5.0 and, in the 100-year floodplains that were studied by detailed methods, shows selected whole-foot base flood elevations or average depths. Insurance agents use the zones and base flood elevations in conjunction with information on structures and their contents to assign premium rates for flood insurance policies.

For floodplain management applications, the map shows by tints, screens, and symbols, the 100-year floodplain. The locations of selected cross sections used in the hydraulic analyses are shown where applicable.

7.0 OTHER STUDIES

A Flood Insurance Study for the Township of Sterling has been published (Reference 7). The results of this study are in agreement with the results of that study.

Due to its more detailed nature, this study supersedes the Flood Hazard Boundary Map for the Township of Lehigh (Reference 6).

8.0 LOCATION OF DATA

Information concerning the pertinent data used in preparation of this study can be obtained by contacting FEMA, the Natural and Technological Hazards Division, Liberty Square Building (Second Floor), 105 South Seventh Street, Philadelphia, Pennsylvania 19106.

9.0 BIBLIOGRAPHY AND REFERENCES

1. Aerial Data Reduction Associates, Inc., of Pennsauken, New Jersey, Aerial Photogrammetric and Field Surveys of Monroe, Wayne and Pike Counties, Pennsylvania, Pennsauken, New Jersey, September 1985 to January 1986.

2. Nortech Surveys (U.S.A.) Inc., Report on the Federal Emergency Management Agency Project, Inertial Elevation Survey for United States Army Corps of Engineers for Aerial Data Reduction Associates, Inc., October/November 1985.

3. U. S. Army Corps of Engineers, Hydrologic Engineering Center, HEC-2 Water Surface Profiles, Users Manual, Davis, California, 1982.

4. Ven Te Chow, Open-Channel Hydraulics, New York, McGraw-Hill, 1959.

5. U. S. Department of the Interior, Geological Survey, 7.5-Minute Series Topographic Maps, Scale 1:24,000, Contour Interval 20 Feet: Sterling, Pennsylvania, 1965, Photorevised 1983; Tobyhanna, Pennsylvania, 1965, Photorevised 1984.

6. Federal Emergency Management Agency, Federal Insurance Administration, Flood Hazard Boundary Map, Township of Lehigh, Wayne County, Pennsylvania, April 11, 1980.

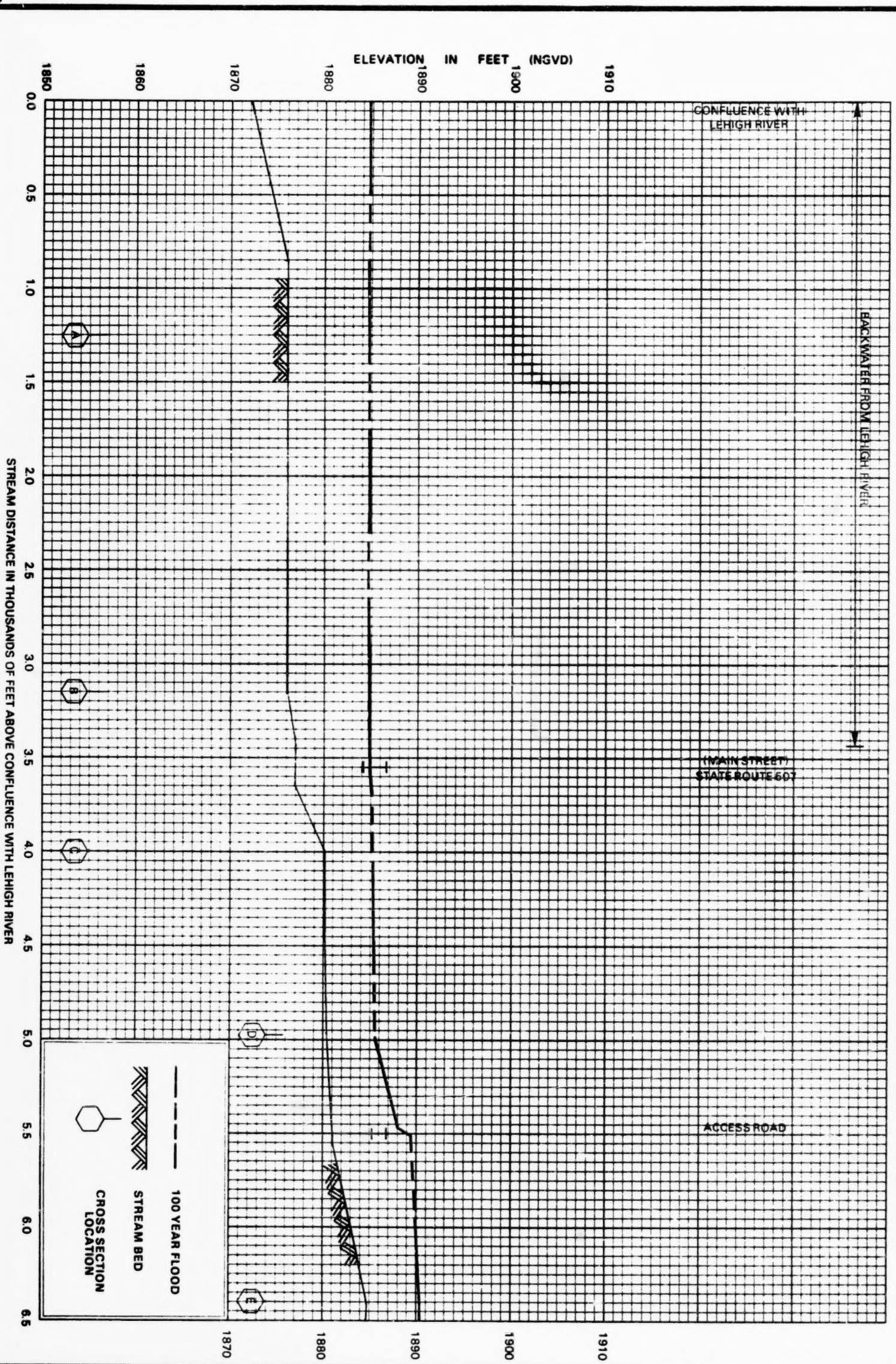
7. Federal Emergency Management Agency, Flood Insurance Study, Township of Sterling, Wayne County, Pennsylvania, Washington, D. C., December 3, 1982.

General Highway Map, Wayne County, Pennsylvania.

EXHIBIT 3 - ELEVATION REFERENCE MARKS

Reference Mark	Elevation (Feet NGVD)	Description of Location
RM 1	1,819.94	Building [illegible] bridge over the [illegible] Street. Square cut at west corner of bridge on top of bridge wall at abutment.
RM 2	1,879.66	Fourth Street bridge over the Lehigh River, PA. Nail in southwest corner of bridge at abutment.
RM 3	1,889.78	Route 407 (Main St.) bridge over Gouldsboro Lake Tributary. Square cut at north corner of bridge on top of bridge wall at abutment.
RM 4	1,886.77	Access road bridge over Gouldsboro Lake Tributary. P.K. nail at west corner of bridge on top stone stringer at abutment.
RM 5	1,878.8	COMSAT bridge over Gouldsboro Lake Tributary. Painted square on east concrete bridge wall over center culvert.

124060



FEDERAL EMERGENCY MANAGEMENT AGENCY

TOWNSHIP OF LEHIGH, PA

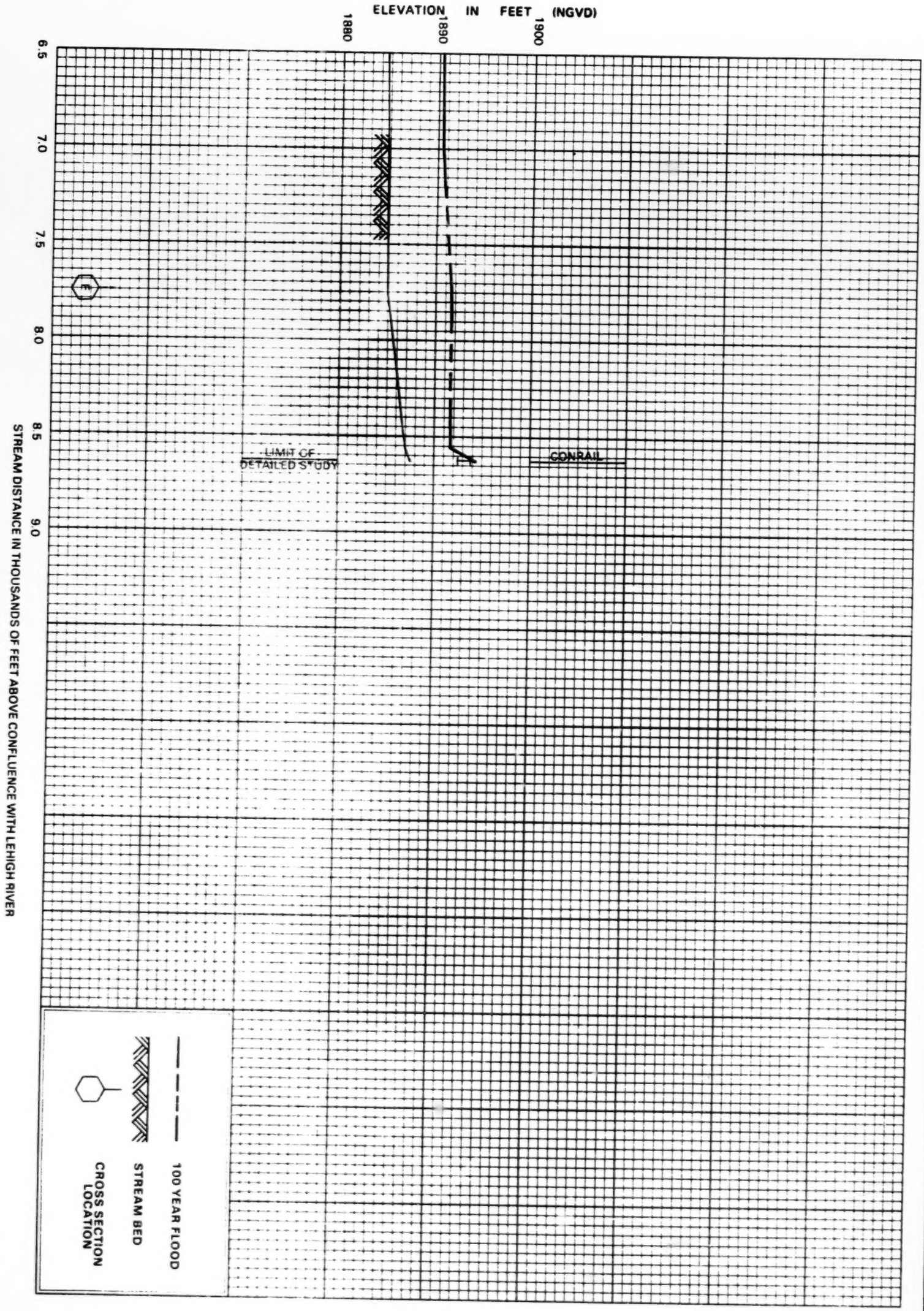
(WAYNE CO.)

FLOOD PROFILES

GOULDSBORO LAKE TRIBUTARY

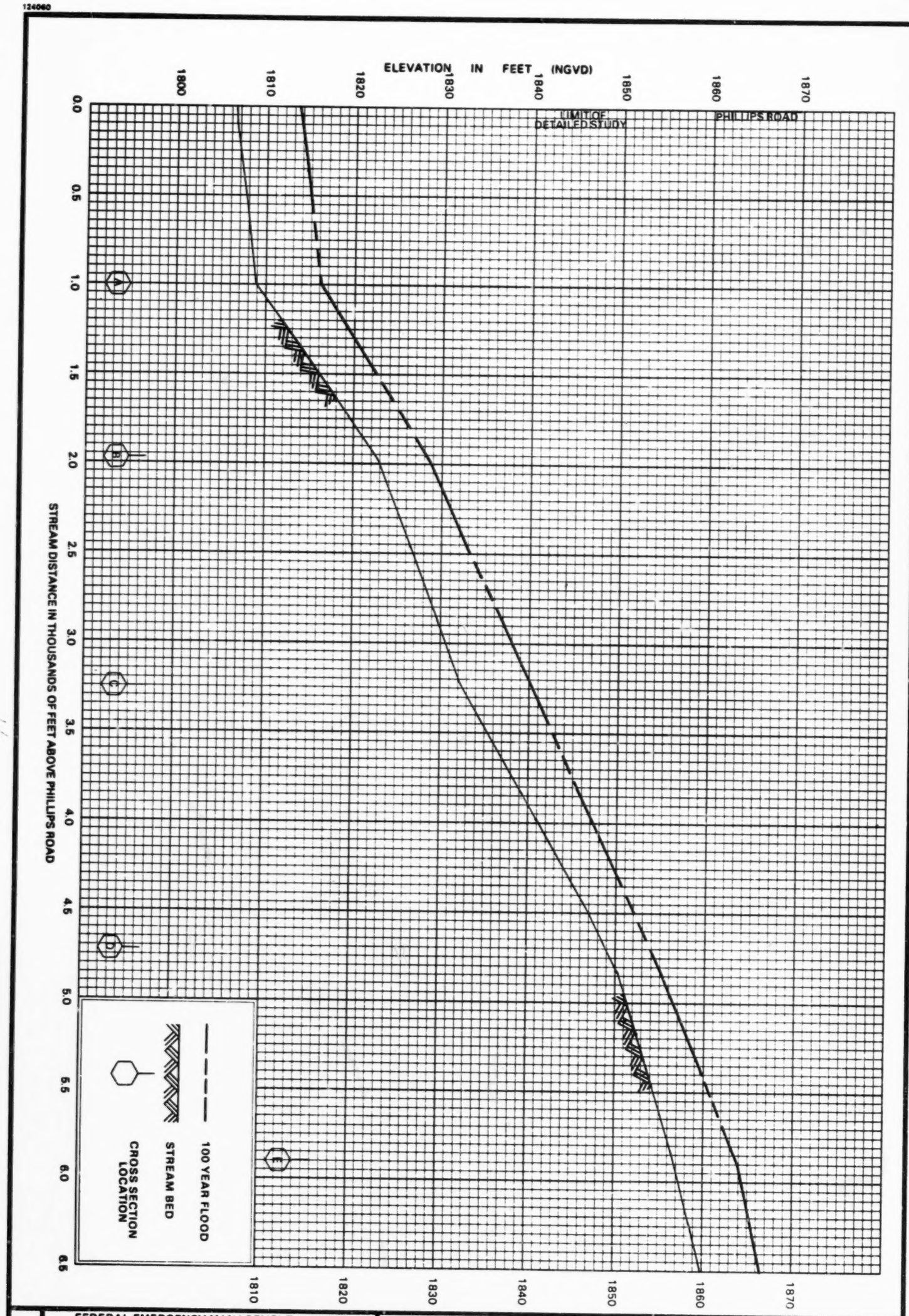
01P

124060



02P	FEDERAL EMERGENCY MANAGEMENT AGENCY TOWNSHIP OF LEHIGH, PA (WAYNE CO.)	FLOOD PROFILES GOULDSBORO LAKE TRIBUTARY

124060



FEDERAL EMERGENCY MANAGEMENT AGENCY

TOWNSHIP OF LEHIGH, PA

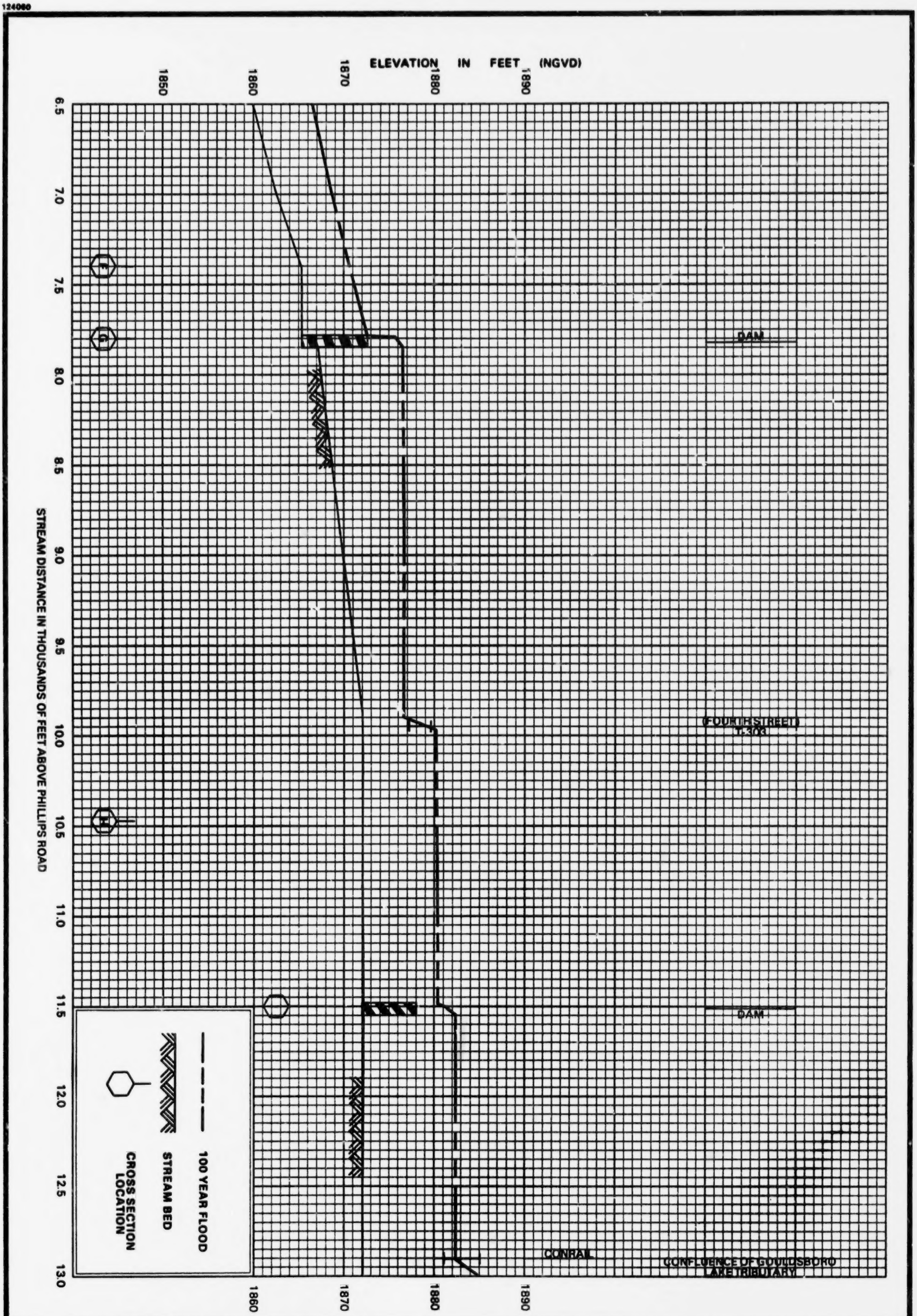
(WAYNE CO.)

FLOOD PROFILES

LEHIGH RIVER

03P

124060



04P

FEDERAL EMERGENCY MANAGEMENT AGENCY

TOWNSHIP OF LEHIGH, PA

(WAYNE CO.)

FLOOD PROFILES

LEHIGH RIVER